

Emerging Oil and Gas Development in Northwestern New Mexico

HORIZONTAL GALLUP / MANCOS PLAY



Gallup / Mancos Oil Play

Northwestern New Mexico

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Introduction

A new oil exploration play is beginning to develop in Sandoval and San Juan Counties, New Mexico. A Calgary based company (with offices in Denver, CO), Encana Oil and Gas (Encana) has recently horizontally drilled and produced oil from the Cretaceous age Gallup sandstone. These wells offset unleased Navajo allotted lands and it is anticipated that Encana and other oil and gas companies will be very interested in leasing Navajo allotment tracts as soon as possible.

Early Play Development and Reported Results

One of Encana's wells, the Lybrook #H36-2307 (located in se se 32-23n-7w, Figure 1) was reported flowing at a rate of 838 mcf/gpd (natural gas) and 786 bopd (oil) from a lateral leg in the Gallup sandstone formation. Daily production through the initial 30-day period was around 440 barrels of oil per day. This well is a horizontal well with a 4,100 foot lateral section. Figure 2B is a cross-section through the Lybrook well and surrounding wells (index map for the cross-section is Figure 2A).

This is a very good well although it is too early in the production history of the well to know the flow rates over time and the ultimate economic recovery. However because the drilling depths are relatively shallow (vertical depth of 5,600 ft and lateral lengths between 6,000 ft to 9,800 ft) the costs to drill and complete these wells is considerably less than, for example, a Bakken shale well.

Five older vertical wells in the vicinity

of the EnCana well have had cumulative production ranging from around 7,800 to 21,000 barrels of oil and 114 million to 345 million cubic feet of gas. These production values are relatively poor except that water production is low, ranging from 1,000 to 3,400 barrels cumulative. It appears the horizontal portion of the EnCana well is in the same zone as the older vertical wells.

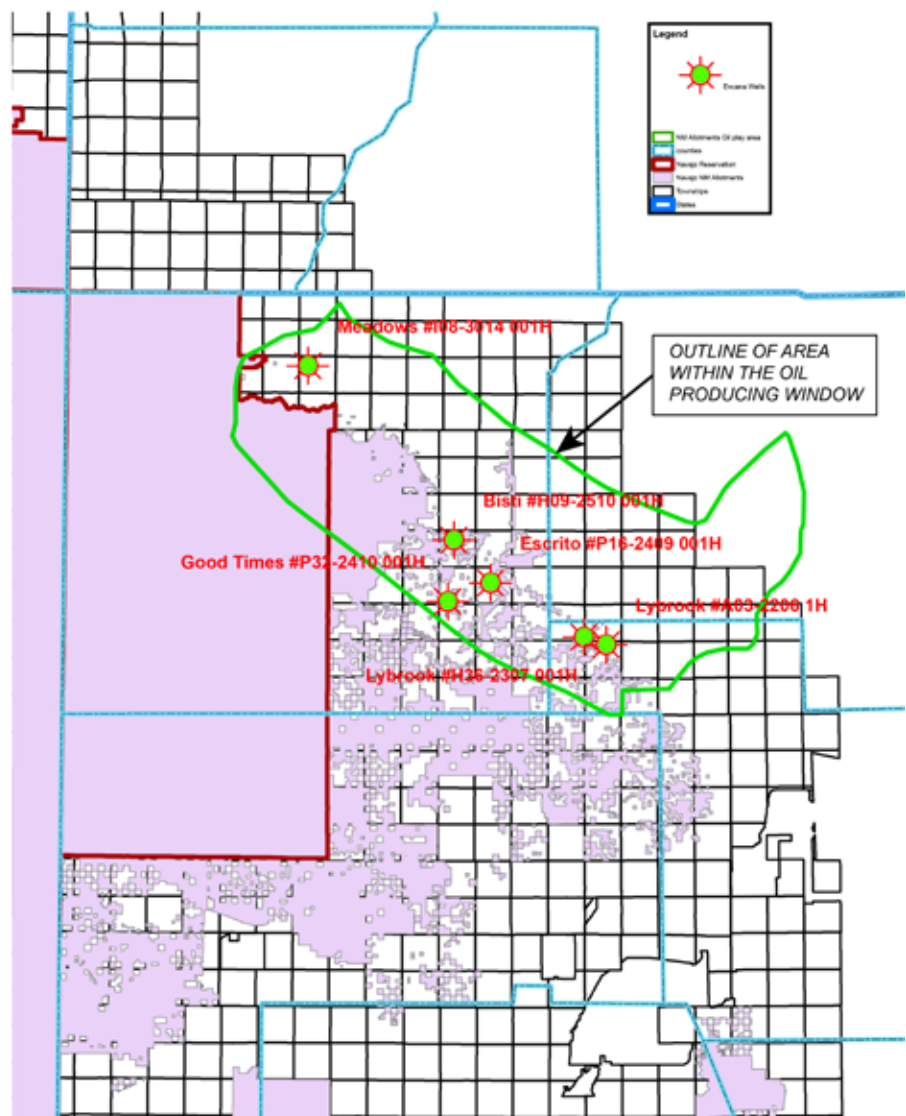


Figure 1: Map of northwestern New Mexico showing Navajo Tribal land and Navajo Allotted lands and the locations of Encana's horizontal wells targeting the Gallup / Mancos formations. Encana's discovery well is the Lybrook H36-2307. Also shown is the outline of the oil window for the Gallup Formation. It is within this area that companies will be focusing their leasing efforts.

Encana Corp. San Juan Basin

From Encana's presentation to their shareholders and investors, July 2012)

TARGET WELL PARAMETERS

Well cost: \$4.3 million
EUR per well: 550 MBOE
Lateral length: 5,000 feet
TVD: 5,500 feet

Encana has also release information on their second Gallup well, the EnCana Good Times P32-2410 #001H. This well has been reported as flowing 57 Mcfgpd and 66 BOPD. Roughly 22 miles northwest of the Lybrook well, the Good Times well is section 32, Township 24 North, Range 10 West. It was placed on pump in June 2012.

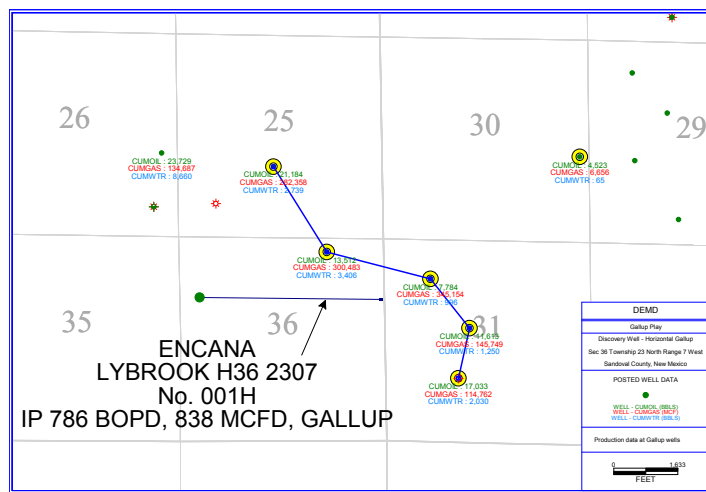
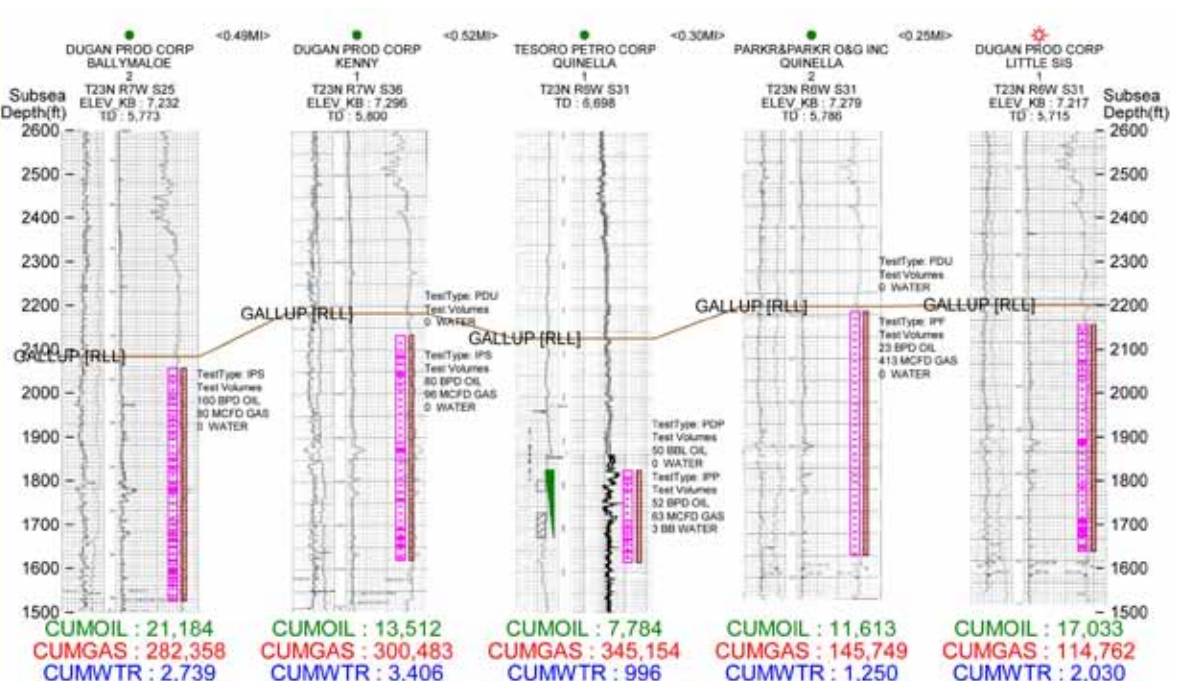


Figure 2A: Index map showing the line of cross-section of wells surrounding Encana's Lybrook horizontal Gallup well.

Figure 2B: Cross-section of wells surrounding Encana's Lybrook horizontal Gallup well. Location of wells is shown in Figure 2A.



Encana has 15 other active or proposed wells listed on the New Mexico Energy Minerals and Natural Resources Department Oil Conservation Division in the Gallup Play. The wells are located from as far northwest as Township 30 North, Range 14 West to Township 23 North Range 6 West on the southeast. Encana holds approximately 168,000 net acres in the region.

Production is from the Gallup Sandstone zone of the lower Mancos Shale Formation. Figure 4 is a regional map of northwest New Mexico showing Encana wells and the Navajo Allotted and Navajo Tribal lands. The producing interval in the five vertical wells is at depths ranging from 5,100 to 5,400 feet with total perforated intervals of approximately 500 feet. The producing zone consists of interbedded shale and sandstone layers with low permeability. They have lower initial potentials and lower ultimate production.

Extent of the Gallup Oil Play

The Gallup Sandstone is not a new oil and gas target in New Mexico. Several conventional vertically drilled oil fields exist in the area, so much is known about the geology of the Gallup. This recent activity is a result of applying new horizontal drilling and hydraulic fracturing technology to an already existing oil fairway. As an example of a Gallup oil field, one of Encana's

newly stated tests is located on the southeast flank of the Lybrook Field, which was discovered in 1956. The conventionally produce field has produced more than 50.3 bcfg of gas and 5.4 million bo from the Gallup. Another field is the Rusty Field, located three miles south of Encana's test. Discovered in 1974, the field produced over 6.8 bcfg of gas and 76,000 bo.

Tocito and Gallup sandstones were deposited as a regressive – transgressive depositional sequence that is productive predominantly on the southern and western sides of the basin (Figure 3). Deposition of these formations was not prevalent in the distal, eastern side of the basin; however lentils or extensions of the main sandstone deposit are present and productive on the reservation.

The greatest potential for new production on the

Navajo Reservation is in the overlying Mancos shale. It was deposited as the Cretaceous seaway inundated the area depositing over 1,500 feet of marine shale in the basin (Figure 5 is a paleomap of New Mexico and surrounding areas during Cretaceous time). Production has been established from vertical wells where natural fracturing has been induced as a result of structural deformation that occurred during basin formation.

Production from the Mancos with vertical wells is highly variable with a majority of wells producing less than one-half of a billion cubic feet of gas or less than 50,000 barrels of oil. Economic producers are the result of a higher degree of fracturing encountered by the well bore. As a result, exploration has focused in structurally complex areas of the eastern basin edge.

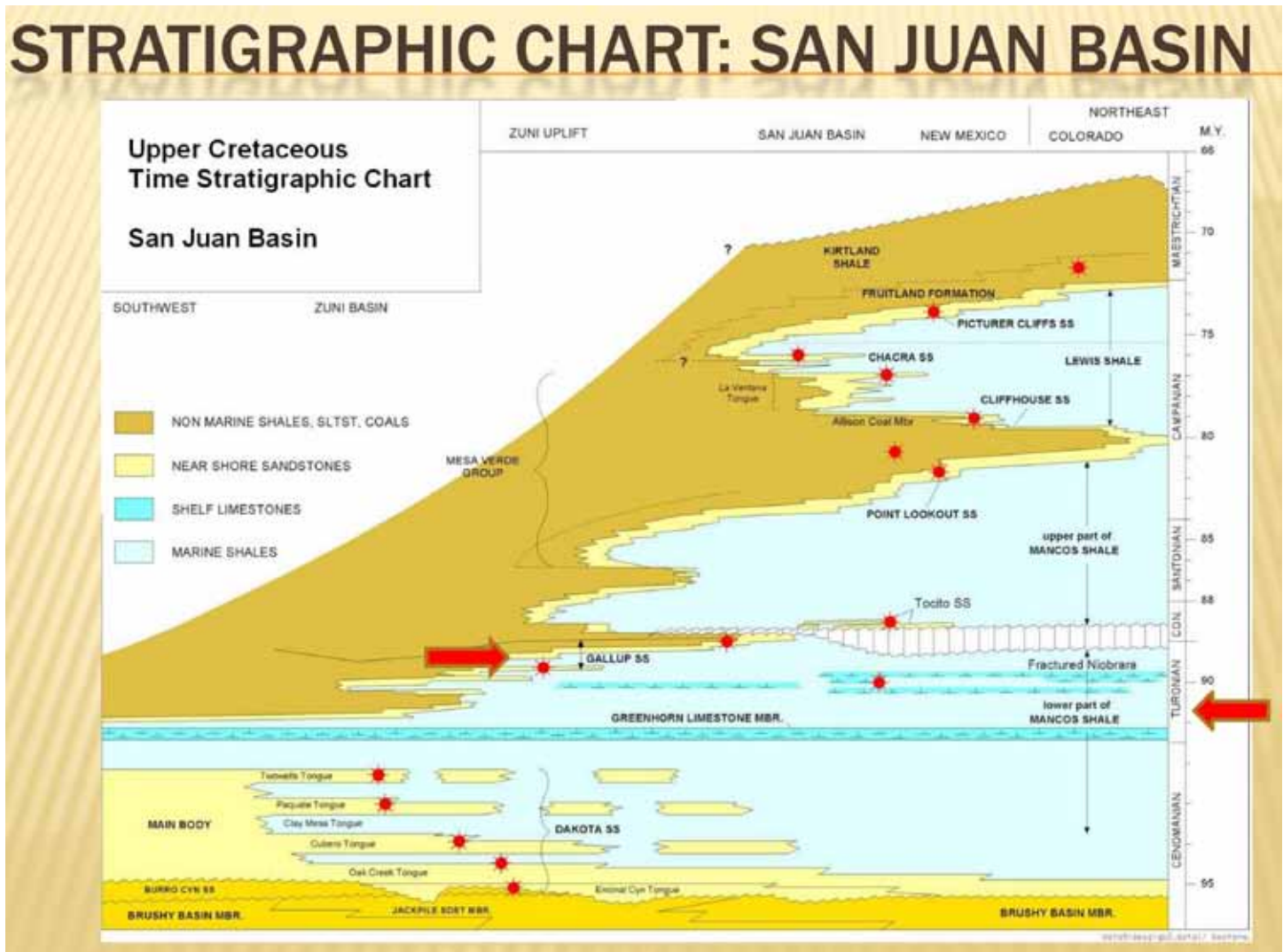
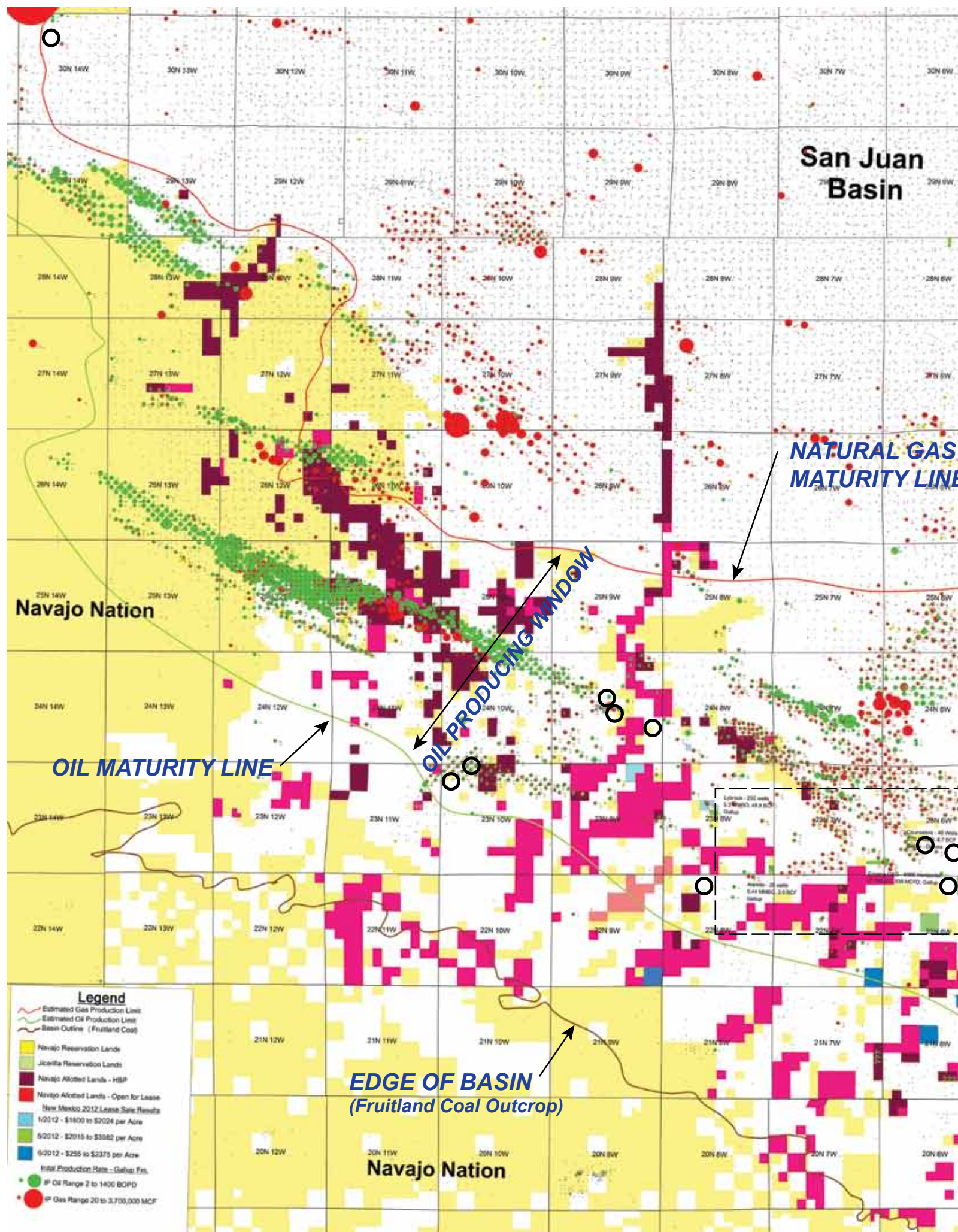


Figure 3. Stratigraphic chart of the San Juan Basin showing the stratigraphic position of the Gallup Sandstone (red arrow) and the surrounding Mancos Shale.



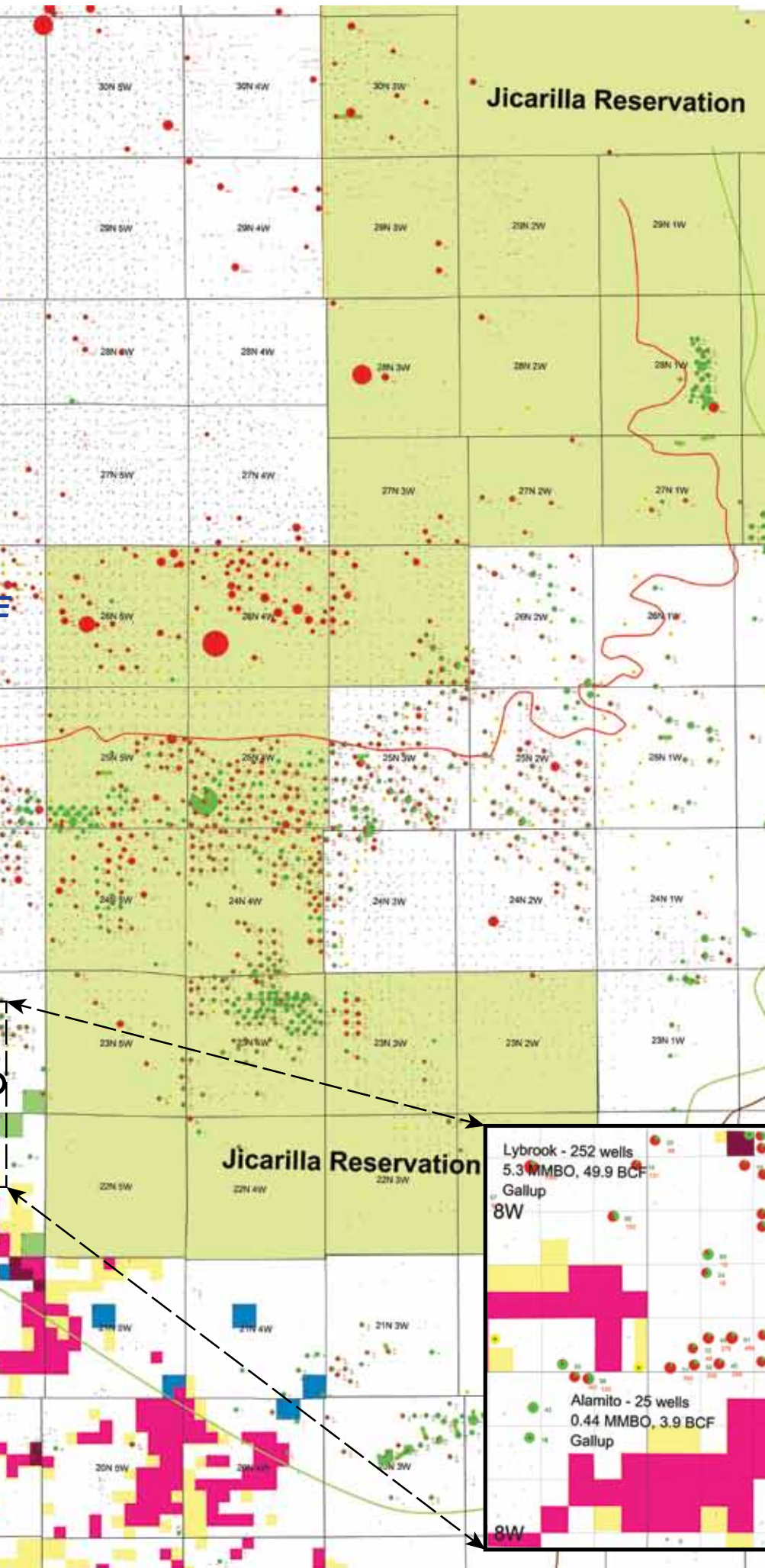


Figure 4. A detailed map of the northwestern corner of New Mexico showing Navajo Allotted and Navajo Tribal lands. Those tracts colored in red are Navajo Allotted lands that are open to be leased. The dark red tracts are Navajo Allotted lands that are held by production (HBP) and are not available for leasing. Lease bonus from a recent State lease sale ranged from \$255 per acre to \$3,982 per acre. It is expected that most of any new leasing will occur within the oil producing area as shown.

AREA SURROUNDING THE ENCANA DISCOVERY HORIZONTAL WELL
Encana Lybrook 1H 001
IP: 786 BO, 838 MCFD

History of Oil and Gas Production in New Mexico

The first well-documented oil discovery in the San Juan Basin occurred in 1911 in the Chaco slope area of New Mexico. The well produced about 12 barrels of oil per day from the Menefee Formation. Gas was discovered in 1921 from the Farmington Sandstone Member of the Kirtland Shale in a well south of Aztec, New Mexico. Subsequently, oil was discovered in the Dakota Sandstone in 1922 west of Farmington which led to additional discoveries on surface structures on the Four Corners platform and gas in the central basin from Pictured Cliffs Sandstone and the Mesaverde Group in the decade. Modest development continued in the next 20 years followed by pipeline development bringing the drilling boom of the 1950s for gas in the Dakota Sandstone, Mesaverde Group, and the Pictured Cliffs Sandstone.

Gallup Sandstone

During this period, the two largest fields to produce from the Gallup Sandstone (also known as Tocito Sandstone Lenticle) of the Mancos Shale, (Figure 2 Bisti and Horseshoe Fields were discovered (Figure 4). The Gallup Sandstone has now produced over 920 billion cubic feet of gas and 173 million barrels of oil from over 3,800 wells in the San Juan Basin. It is by far the greatest oil producing horizon in the San Juan Basin.

The discovery well in the Gallup Sandstone (Tocito Lenticle) in the Bisti area was El Paso Natural Gas Company Kelly State No. 1 (Section 16, Township 25 North, Range 12 West), completed in 1955 from an interval of 4760-4842 feet. Initial potential (IP) was 180 barrels oil per day (BOPD). Subsequent productive wells in



Figure 5. The Mancos Shale was deposited in the Cretaceous Seaway, at which time New Mexico was divided by an inland sea. This inland sea also cut across the North American continent throughout the Cretaceous era. The shale deposited in the western part of the seaway provided the source for today's major Rockies shale plays, such as the Niobrara and Gallup.

Bisti Field had IPs ranging from 100 to 700 BOPD. The sandstone zones which produce are generally considered to have been deposited as offshore bars, as indicated by greater length than width, coarser grain character developing upward, and cleaner (less silt and shale size particles) well-sorted sands. Bisti Field has produced 79.5 Bcfg and 42 MMBO.

Bisti and other fields such as Horseshoe, Gallegos

Formation	Cum Gas (mcf)	Cum Oil (Bbls)	Cum Water (Bbls)	Well Count
Chacra	171,687,665	60,490	795,230	566
Dakota	6,904,170,759	69,068,317	114,602,952	7,780
Fruitland	16,687,743,952	344,790	842,380,287	8,543
Gallup	920,036,304	173,139,083	273,869,975	3,827
Hospah	33,603	17,832,296	380,467,839	245
Lewis/Mesaverde	167,916,024	391,136	523,944	317
Mancos	96,259,320	28,833,591	1,989,249	316
Mesaverde	11,736,498,030	45,142,064	31,431,788	6,880
Pictured Cliffs	4,080,968,420	973,615	22,073,342	5,926
TOTAL	40,765,314,077	335,785,382	1,668,134,606	34,400

Table 1. Cumulative production by geologic formation in the San Juan Basin.

and Kutz are located in what is considered to be the oil-prone window, with wells farther to the north notable for producing gas. Petroleum is generated by increasing burial depth causing increased temperature of source rocks. The resulting product depends upon the depth in large degree. Shallow deposits can generate methane gas by biogenic decomposition. Examples are coal-bed methane and biogenic gas in formations such as shallow Niobrara chinks and organic rich shale. Deeper burial increases temperature and pressure to a point where source beds will produce crude oil. Further burial will cause the oil to break down, resulting in wet gas and finally, dry gas at even greater depths. This process is evidenced by conditions in the San Juan Basin as described above.

Horizontal Drilling and Hydraulic Fracturing

Horizontal drilling has been utilized with varying degrees of success since the 1970s. The process generally involves drilling vertically to or near the top of the target formation and then turning into the target on a horizontal leg for the purpose of exposing more of the productive zone to the well bore and intersect-

ing vertical fractures to increase production. Recent technological innovations in drilling and steering the bit to stay within the target formation have increased the success rate of the process. Production is further enhanced by multiple stage fracturing to concentrate pressures and increase subsequent fracture length. Care is taken to determine and use appropriate fluids in order to decrease damage to the formation.

Although horizontal drilling and hydraulic fracturing in recent years have been instrumental in greatly increasing the country's oil and gas reserves, these methods must be applied appropriately. Cumulative well production must be sufficient to pay for finding costs. Even in trends such as that of the Gallup, economics will determine activity. Product prices must be high enough to entice exploration and

development.

Drilling, Completion and Production Activity as of August, 2013

Since the Lybrook H36 well announcement, EnCana has reported approximately twelve additional well completions, and subsequent production data through June 2013 (refer to Fig. 6). Results are varied as indicated by initial potentials and production data. It is still a bit too early to accurately gauge the strength of the play. All unconventional plays to date have gone through an initial period of determining best drilling and completion procedures and implications of the rock characteristics.

The Lybrook H36 discovery well has produced nearly 50,000 barrels of oil in its first 15 months. Other wells in the vicinity of the Lybrook H36 well have positive initial results. Four miles east-southeast, the Lybrook A03 2206 1H produced 34.2 thousand barrels of oil (MBO) in its first 3 months and just over one mile west-northwest, the Lybrook H26 2307 1H

produced 21.8 MBO in its first three months. One and one-half miles south of the H36 well, the Lybrook P01 2207 1H produced 10.7 MBO in its first two months.

Farther to the west-northwest, the Escrito I24 2409 1H (Section 24 Township 24 North Range 9 West) produced 50.7 MBO and 111 MMcf gas in its first 9 months. Three miles west-northwest of that well, the Escrito I16 2409 1H produced 14.7 MBO and 22 MMcf in its first 4 months. In the same section the Escrito P16 2409 1H produced 19.6 MBO and 131 MMcf in 14 months.

EnCana has completed three wells in their Good Times area, about 7 miles west-southwest of the Escrito wells. Good Times I32 2410 1H (Section 32 Township 24 North Range 10 West) has produced 16.9 MBO and 28 MMcf gas in 11 months. An immediate south offset, Good Times P32 2410 produced 27.8

MBO and 28 MMcf gas also in 11 months. In section 6 Township 23 North Range 10 West, a mile southwest of the two previously discussed, the Good Times A06 2310 1H produced 7.5 MBO and 16.5 MMcf gas in 9 months.

Removed some nine miles to the north of other EnCana wells, the Bisti H09 2510 1H well (Section 9, Township 25 North Range 10 West) has produced 9.2 MBO and 38.3 MMcf gas, indicative of changing gas-oil ratio.

WPX Energy Production is now also active in this area. Two completions and preliminary production data have been announced. The WPX Chaco 2408 32P 114H (Section 32 Township 24 North Range 8 West) has produced 20.8 MBO in its first 4 months. Two miles to the south the WPX Chaco 2308 161 produced 13.5 MBO in its first 3 months production. A number of additional locations have been permitted by WPX as indicated on the map.

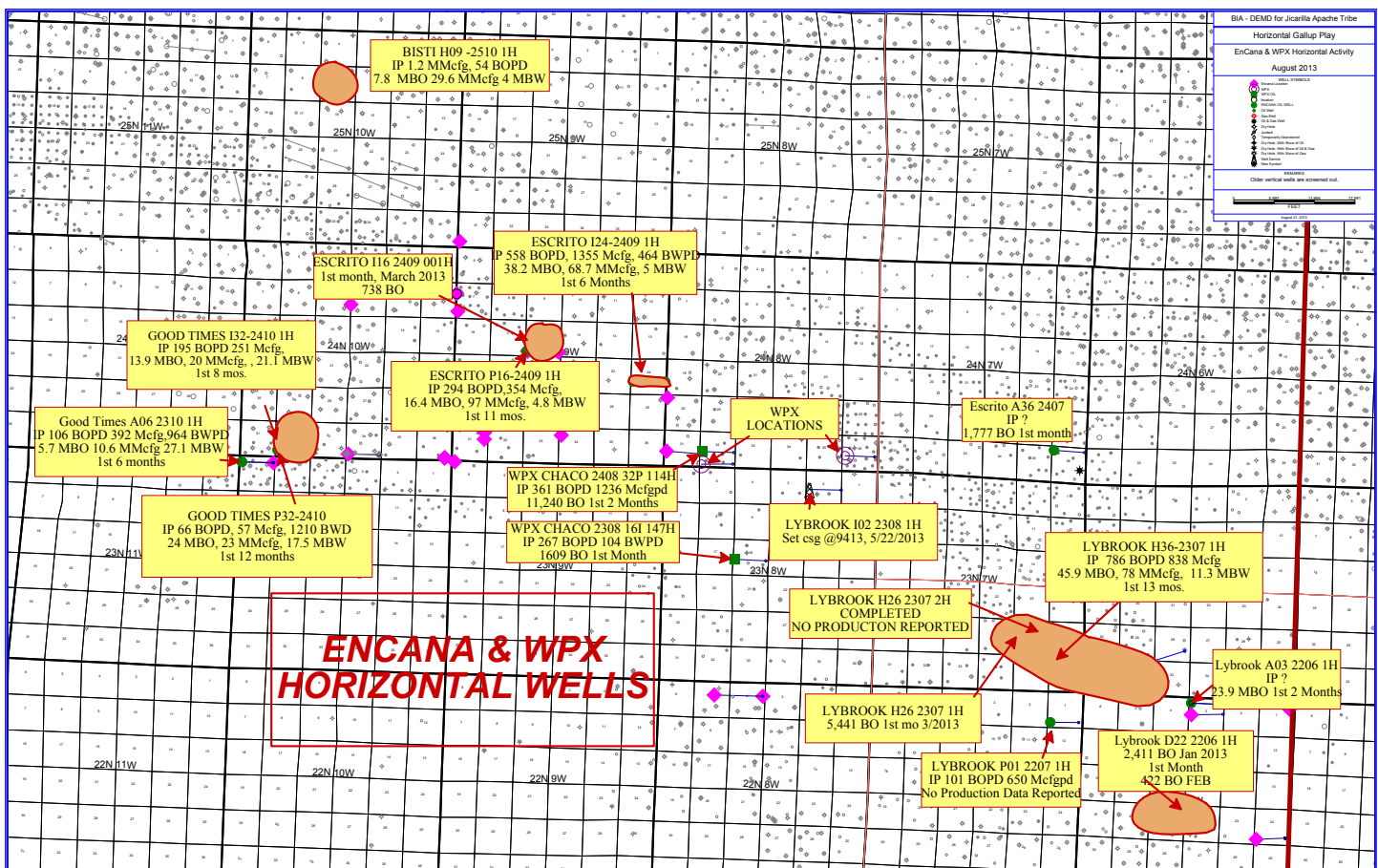


Figure 6. Map showing drilling activity as of August, 2013. WPX Energy, Inc. has now entered the play and expects to drill 8-10 development wells in the area. Maximum rates of their first four wells were 488, 623, 1,004, and 800 boe/d. The company stated it has already spudded three of the development wells. WPX is drilling 4,300-ft laterals in Gallup at 5,400 ft true vertical depth. The company didn't give the location of the discovery but said it is in an area of the basin that is not subject to seasonal closures. The company expects the new field to be producing 3,400 boe/d by yearend. Oil is trucked to a nearby pipeline injection point.

CONTACT INFORMATION

For more information regarding the leasing of Navajo Indian lands, please contact the Bureau of Indian Affairs - Navajo Regional Office, at:

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